

1 **CLAIMS**

2 1. An animation rendering system, comprising:

3 a high-level animation subsystem that handles interaction functions for the
4 system;

5 a low-level animation subsystem that handles display functions for the
6 system;

7 at least one high-level clock that is referenced by high-level animation
8 operations;

9 at least one low-level clock that is referenced by low-level animation
10 operations;

11 a communications channel for sending messages between the high-level
12 animation subsystem and the low-level animation subsystem according to a
13 communications protocol; and

14 wherein the communications protocol includes information provided to the
15 low-level animation subsystem by the high-level animation subsystem that
16 designates an animation and specifies how the animation is to change over a
17 specified period of time, thereby ensuring that the low-level animation system has
18 information to process several frames of the animation.

1 2. The animation rendering system as recited in claim 1, wherein the
2 communications between the high-level animation subsystem and the low-level
3 animation subsystem are asynchronous.

4
5 3. The animation rendering system as recited in claim 1, wherein:
6 the low-level animation subsystem renders animations at a constant display
7 frame refresh rate; and
8 the high-level animation subsystem handles interactions at a variable rate
9 that is slower than the constant display frame refresh rate.

1 4. The animation rendering system as recited in claim 1, wherein the
2 communication protocol further comprises at least one message sent from the low-
3 level animation subsystem to the high-level animation subsystem to handle
4 synchronization between the high-level animation subsystem and the low-level
5 animation subsystem.

6
7 5. The animation rendering system as recited in claim 4, wherein one
8 message sent from the low-level animation subsystem to the high-level animation
9 subsystem further comprises a “synchronize with media slip” message that
10 identifies a target clock associated with an animation and an amount that the target
11 clock must slip to synchronize the high-level animation subsystem with the
12 animation being run by the low-level animation subsystem.

13
14 6. The animation rendering system as recited in claim 1, wherein:
15 the high-level animation subsystem further comprises a high-level timing
16 engine;

17 the low-level animation subsystem further comprises a low-level timing
18 engine; and

19 the communication protocol further comprises the following parameterized
20 messages that are sent from the high-level timing engine to the low-level timing
21 engine:

22 a create clock message with initial clock properties parameter;

23 an update properties message with a target clock parameter and an
24 updated properties parameter;

1 an add interval message with a target clock parameter and an interval
2 properties parameter;

3 a reset synchronization slip message with a target clock parameter;

4 a remove all intervals message with a target clock parameter; and

5 a delete clock message with a target clock to delete parameter.

6
7 7. The animation rendering system as recited in claim 1, wherein:

8 the high-level animation subsystem further comprises a high-level
9 animation objects database;

10 the low-level animation subsystem further comprises a low-level animation
11 objects database; and

12 the communication protocol further comprises the following parameterized
13 messages that are sent from the high-level animation objects database to the low-
14 level animation objects database:

15 a create animation message with an output value type parameter, an
16 animation function parameter and a controlling clock parameter;

17 an update animation message with a target animation parameter and
18 an updated properties parameter;

19 a create animation collection message with a list of animations
20 parameter;

21 an add animation to collection message with a target animation
22 collection parameter and an animation to add parameter;

23 a remove animation to collection message with a target animation
24 collection parameter and an animation to remove parameter;

1 a create static value message with a value type parameter and an
2 initial value parameter; and
3 an update static value parameter with a target static value object
4 parameter and a new value parameter.

5
6 **8.** A method for processing an animation application, comprising:
7 receiving animation data from the animation application into a high-level
8 animation subsystem;
9 transmitting animation information from the high-level animation
10 subsystem to a low-level animation subsystem according to a communication
11 protocol over a communications channel so that the low-level animation
12 subsystem can display an animation associated with the animation data;
13 wherein the communication protocol provides for designating an animation
14 and for instructions regarding how the animation should change over a particular
15 time period so that the low-level animation subsystem can process several frames
16 of the animation at a constant display frame refresh rate while the high-level
17 animation subsystem executes at a variable refresh rate.

1 **9.** The method as recited in claim 8, further comprising the high-level
2 animation subsystem receiving at least one protocol message from the low-level
3 animation subsystem to assist in keeping a timing element in the high-level
4 animation subsystem synchronized with at least a timing element in the low-level
5 animation subsystem.

6
7 **10.** The method as recited in claim 8, wherein the communication
8 protocol includes the following messages that are sent from a high-level animation
9 subsystem timing element to a low-level animation subsystem timing element:

10 a message to create a clock;
11 a message to update clock properties;
12 a message to add an interval to a clock;
13 a message to remove all intervals for a clock; and
14 a message to delete a clock.

15
16 **11.** The method as recited in claim 10, wherein the communication
17 protocol further includes the following messages that are sent from a high-level
18 animation subsystem timing element to a low-level animation subsystem timing
19 element:

20 a message to reset a synchronization slip value in the low-level animation
21 subsystem.

1 **12.** The method as recited in claim 8, wherein the communication
2 protocol includes the following messages that are sent from a high-level animation
3 subsystem animation object element to a low-level animation subsystem animation
4 object element:

- 5 a message to create an animation;
- 6 a message to update an animation;
- 7 a message to create an animation collection;
- 8 a message to add an animation to an animation collection; and
- 9 a message to remove an animation from an animation collection.

10
11 **13.** The method as recited in claim 8, wherein the communication
12 protocol includes the following messages that are sent from a high-level animation
13 subsystem animation object element to a low-level animation subsystem animation
14 object element:

- 15 a message to create a static display value; and
- 16 a message to update a static display value.

17
18 **14.** A system, comprising:
19 a high-level animation subsystem configured to receive animation
20 information from an application;
21 a low-level animation subsystem configured to render one or more
22 animations according to the animation information;
23 a low-level timing engine configured to monitor one or more low-level
24 clocks in the low-level animation subsystem and to synchronize the low-level
25 clocks with one or more high-level clocks;

1 a high-level timing engine configured to monitor one or more high-level
2 clocks in the high-level animation subsystem according to one or more high-level
3 animation objects and to transmit animation messages to the low-level timing
4 engine, the animation messages conforming to a communication protocol; and

5 wherein the animation messages that are transmitted from the high-level
6 timing engine to the low-level timing engine designate one or more animation
7 objects and how the animation objects are to change over a specified period of
8 time.

9
10 **15.** The system as recited in claim 14, wherein the low-level timing
11 engine synchronizes a low-level clock with a high-level clock by sending a
12 “synchronize with media slip” message that identifies the high-level clock and an
13 amount by which the high-level clock must slip to maintain synchronization with a
14 low-level clock that corresponds to the high-level clock.

1 16. The system as recited in claim 14, wherein the communication
2 protocol further comprises the following messages:

3 a create clock message that identifies clock properties;

4 an update properties message that identifies updated clock properties;

5 an add interval message that adds a timing interval to clock properties;

6 a remove intervals message that removes timing intervals from clock
7 properties; and

8 a delete clock message that deletes a clock.

9
10 17. The system as recited in claim 14, wherein the communication
11 protocol further comprises the following messages:

12 a create animation message that creates an animation;

13 an update animation message that updates an existing animation;

14 a create animation collection that identifies multiple animations to be
15 grouped;

16 an add animation to collection message that identifies an animation to add
17 to an identified animation collection; and

18 a remove animation to collection message that identifies an animation to
19 remove from an identified animation collection.

20
21 18. The system as recited in claim 14, wherein the communication
22 protocol further comprises the following messages:

23 a create static value message that identifies a value type and an initial value
24 to display; and
25

1 an update static value message that identifies a static value to update and a
2 new value for the static value.
3

4 **19.** The system as recited in claim 14, wherein the low-level timing
5 engine is configured to send a synchronization message to the high-level timing
6 engine according to the communication protocol that identifies a high-level clock
7 and measure of how much the high-level clock should be altered to synchronize
8 the high-level clock with a low-level clock.
9

10 **20.** The system as recited in claim 14, further comprising:
11 at least one low-level animation object;
12 at least one high-level animation object configured to communicate with
13 the low-level animation objects through communication protocol messages to
14 create and update the low-level animation objects to reflect the high-level
15 animation objects.
16

17 **21.** A high-level animation subsystem in an animation rendering system,
18 comprising:

19 one or more high-level clocks;
20 a high-level timing engine configured to track the one or more high-level
21 clocks;

22 one or more animation objects that identify at least a portion of an
23 animation;

24 means for transmitting animation data to a low-level animation subsystem
25 according to messages included in a communication protocol; and

1 wherein the communication protocol messages transmitted to the low-level
2 animation subsystem identifies at least one of the animation objects in the low-
3 level animation subsystem and provides data regarding how the identified
4 animation objects are to change over a specified period of time.

1 **22.** The high-level animation subsystem recited in claim 21, wherein the
2 communication protocol further comprises the following messages:

3 a create clock message that identifies initial clock properties;
4 an update properties message that identifies updated clock properties;
5 an add interval message that identifies an interval to be added to a clock;
6 a remove all intervals message that identifies a clock from which all
7 intervals are to be removed; and
8 a delete clock message that identifies a clock to be deleted.

9
10 **23.** The high-level animation subsystem recited in claim 21, wherein the
11 communication protocol further comprises the following messages:

12 a create animation message that describes an animation to create; and
13 an update animation message that identifies an animation to update and
14 updated properties.

15
16 **24.** The high-level animation subsystem recited in claim 21, wherein the
17 communication protocol further comprises the following messages:

18 a create animation collection message that identifies multiple animations
19 that are to be grouped as one animation collection;
20 an add animation to collection message that identifies an animation to be
21 added to an identified animation collection; and
22 a remove animation from collection message that identifies an animation to
23 be removed from an identified animation collection.

1 **25.** The high-level animation subsystem recited in claim 21, wherein the
2 communication protocol further comprises the following messages:

3 a create static value message that identifies a value type and an initial value
4 to render; and

5 an update static value message that identifies a static value to update and a
6 new value for the static value.

7
8 **26.** A low-level animation subsystem in an animation rendering system,
9 comprising:

10 one or more low-level clocks;

11 one or more low-level animation objects that identify at least a portion of
12 an animation;

13 a low-level timing engine configured to track the one or more low-level
14 clocks with regard to the one or more low-level animation objects;

15 wherein the low-level clocks and the low-level animation objects are
16 created and updated through communication protocol messages received at a
17 variable rate from a high-level animation subsystem in a manner that provides the
18 low-level animation subsystem with several frames of animation data that can be
19 displayed at a high, constant display frame refresh rate.